Latent separability and price variation in the estimation of demand System

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Abstract

The aim of this paper is to overcome the problems caused by insufficient price variation in estimating a large demand system. For that, we propose a new form of Stone-Lewbel (SL) cross section prices developed under latent separability that explore individual specific variation in the composition of the bundles of exclusive goods. The estimation of demand system under latent separability needs the choice of at least one exclusive good per group. We estimate Quadratic Almost Ideal Demand System (QAIDS) under weak and latent separability using traditional aggregate price indices and SL prices. Our empirical analysis is based on fifteen non durable goods of a Tunisian Family Expenditure Survey Data. The results show greater differences among effects price and estimates of price elasticities obtained under weak separability and latent separability using both traditional price indices and SL prices. We obtain higher precision of estimates of own price elasticities using SL prices under latent separability.

Classification JEL: C13-D11-D12

Key Words: Latent separability, Weak separability, Demand system, Exclusive goods, Price variation, SL prices.

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1. Introduction

The estimation of large demand system is empirically difficult because demand functions depend on the prices of all goods. The issue is to impose strong restrictions via separability. This later has been introduced in consumer preferences to resolve the consumer's allocation problem when faced by a disaggregated demand system. Gorman (1959) showed that weak separability equivalent to two stage budgeting rule of Strotz (1957). In the first stage, total expenditure is allocated over broad groups of goods and quantities are chosen optimally given expenditures. In the second stage, group expenditures are allocated over elementary commodities. Hence, imposing weak separability have played an important role in the theoretically and empirical analysis of consumer behavior. It allows a natural grouping of related commodities that reflect the budgeting decisions of consumers. This concept presents a specific shortcoming that possible substitution effects among goods are completely hidden when a high disaggregation of commodities is used. This leads to a problem of multicolinearity that makes difficult to identify price effects and that restricts the usefulness of estimated demand systems for the analysis of consumer behavior.

Blundell and Robin (2000) proposed a new concept of separability that overcomes the problem of multicolinearity: latent separability. This later is equivalent to weak separability in latent rather than purchased goods. Only purchased goods are directly observed and these can be used by the consumer in more than one group. Latent separability supposes to construct broader aggregates that called exclusive goods. These goods could be enter one single commodity group. Their number is imposed by a rank test of an estimated parameter matrix and the decision about them is based on empirical intuition.

This paper examines an other problem caused by insufficient and measurement error ridden price variation for estimating large consumer demand systems. This problem was suggested by Lewbel (1989) are aggravated by the fact that aggregate prices exhibit extremely strong serial correlation Hoderlein and Mihaleva (2008). As a consequence, price effects are only imprecisely estimated. To overcome this problem, lewbel(1989) elaborated an older idea by Stone. It consists to construct a cross section prices that explore individual specific variation in the composition of the bundles of goods. He suppose that all individuals have identical Cobb Douglas preferences for all goods within a given bundles of goods. So, the price of the bundle is simply a linear combination of the individual prices using the some weights for all individuals. These individual specific prices are now our new cross section prices that call Stone-Lewbel (SL) cross section prices.

The structure of the paper is organized as follows. Section 2 presents the concept of latent separability and a construction of latent SL prices. Section 3 presents the data used in this study and empirical results obtained by estimating QAIDS model with classic price indices and SL prices. Finally section 5 provides concluding remarks.

2. Latent separability and Stone-Lewbel cross section prices

2.1 Latent separability

The concept of latent separability has been proposed by Blundell and Robin (2000), but it was implicitly present in Gorman's paper on the theory of aggregation for capital inputs Gorman (1995) or the theory of household production Chiappori (1988). To define this concept, it is useful to start from the definition of weak separability.

Definition 1:

Suppose that household's preferences are defined over goods q_i, $i = 1, \ldots, n$. A direct utility function satisfies the weak separability if the preferences can be written as:

$$U(q_1, q_2, \ldots, q_n) = F(U_1(q^1), \ldots, U_m(q^m))$$

in which the q^k denotes the vector of consumption in group k, U be a utility function representing strictly convex preferences, F is a regular aggregator function increasing in all its arguments and $U_m(.)$ are regular intermediate utility functions.

The structure of preferences under latent separability is shown to be equivalent under weak separability in latent rather than purchased goods. This later can be used by the consumer in more than one group. Latent separability permits to observed goods to be utilized in the production of more than one intermediate good. We denote the latent input in group k as $\tilde{q}_i^k$ with $\tilde{q}^k = \left(\tilde{q}_1^k, \ldots, \tilde{q}_n^k\right)$.

Definition 2:

A direct utility function satisfy the property of latent separability if it can be written as

$$U(q) = \max\left\{F\left(U_1\left(\tilde{q}^1\right), \ldots, U_m\left(\tilde{q}^m\right)\right); \sum_{k=1}^{m} \tilde{q}^k = q\right\}$$

Where $F : IR^m \to IR$ and $U_k : q \in IR_+^n \to U_k(q) \in IR_+$ are increasing and differentiable strictly quasi-concave functions.

The composition of the individual latent elements is determined by the choice of at least one exclusive good per group[2].The idea of exclusive good was imposed to identify the composition of each latent group.

2.2 Stone-Lewbel cross section prices

We assume a latent separable utility function $F\left(U_1\left(\tilde{q}^1, z\right), \ldots, U_m\left(\tilde{q}^m, z\right)\right)$ where $U_k\left(\tilde{q}^k, z\right)$ is the produced intermediate utility depends on the part of the vector of total consumption goods that is devoted to k^{th} intermediate utility production process and on a vector z of observable demographic characteristics.[3] Each of the n purchased goods is shared out across the production of m intermediate goods, $q_i = \tilde{q}_i^1 + \tilde{q}_i^2 + \ldots + \tilde{q}_i^m$ for $i = 1, \ldots, n$.

[2] The idea of exclusive goods is found explicitly in the work of (chiappori1988) on the collective models of household behavior

[3] Let $z*$ be a vector of some constant value of z for a reference household. We take as reference household, the one with two children

We consider m exclusive goods, we denote m_k the number of goods in exclusive group k. The budget share of exclusive group k is given by $\tilde{w}_{k=}\frac{\tilde{x}_k}{x}$, where $\tilde{x}_k$ be total expenditures on exclusive group k and x be total expenditures. The within group budget share of jth good in exclusive group k, relative to total expenditures in exclusive group k is given by $\tilde{w}_{kj}=\frac{b_{kj}(p)\tilde{q}_{kj}}{\tilde{x}_k}$, where $\tilde{q}_{kj}$ and $b_{kj}(p)$ are the quantity and the price of the jth good in exclusive group k. The vectors of all quantities and group price aggregators are given by $\tilde{q}$ and $b(p)$ where $b=(b_1(p),\ldots,b_m(p))^t$.[4]

Under latent separability the total expenditure and substitution possibilities for any non exclusive good can work through more than one channel, thus relaxing the restrictions on total expenditure and substitution possibilities for goods in the same group under homothetic weak separability. For that, our focus will be on the case of homothetic latent separability[5] which implies the existence of functions v_k such that $\tilde{\pi}_k = v_k(b_k(p), z*)$ where $\tilde{\pi}_k$ are latent price index. Consequently, according to lewbel (1989) the equivalence scale E_k can be written as:

$$E_k = \frac{v_k(b(p),z)}{v_k(b(p),z*)}$$

Hence, the latent Stone-Lewbel $(S\tilde{L})$ price for the group k are defined as:

$$S\tilde{L}_k = E_k\tilde{\pi}_k = v_k(b_k(p),z) \text{ for } k=1,\ldots,m$$

The within-group latent budget share demand is given by:

$$\tilde{w}_{kj} = h_{kj}(b_k(p),z,x_k)$$

If we assume that demands are latent homothetically separable then x_k drops out of h_{kj} and

$$\log(\tilde{v}_k(b_k(p),z) = b_{kj}(p)\int h_{kj}(b_{kj}(p),z)db_{kj}(p) \qquad \text{for } j=1,\ldots,m_k$$

From the estimation of h_{kj}, we can construct the latent cross section prices Stone-Lewbel denoted by $S\tilde{L}_k(p)$. Since $S\tilde{L}_k(p) = \tilde{v}_k(b_k(p),z)$, so we can use these prices in place of price aggregators $b_k(p)$ in estimation of a latent demand system.

We consider that the subtechnology functions are Cobb-Douglas:

$$u_k(\tilde{q}_k,z) = \tilde{\lambda}_k\prod_{j=1}^{m_k}\tilde{q}_{kj}^{\tilde{w}_{kj}}$$

Where $\tilde{\lambda}_k$ is a scaling factor, given by

$$\tilde{\lambda}_k = \prod_{j=1}^{m_k}\tilde{w}^*{}_{kj}^{-\tilde{w}^*{}_{kj}}$$

Where $\tilde{w}^*{}_{kj}$ is the latent budget share of good j in group k of the reference household, then the $S\tilde{L}$ can be written as:

[4] The vector of group price aggregators b can be grouped into m linearly homogenous price aggregators denoted by $b_k(p)$ where m the number of latent groups. We assume that the aggregate price indices have the following form $\ln b(p) = \Pi \ln p$ where $\Pi = [\pi_i^k]$ a $(m\times n)$ matrix, the π_i^k terms measure the latent input of good i in group

[5] Homothetic separability refers to latent separability when the subutility functions are homogenous of degree on

$$\widetilde{SL}_k(p) = v_k(b_k(p), z)$$
$$= \frac{1}{\tilde{\lambda}_i} \prod_{j=1}^{m_k} \left(\frac{b_{kj}(p)}{\tilde{w}_{kj}} \right)^{\tilde{w}_{kj}}$$

These prices can be used now in place of a group price aggregates $b_k(p)$ to estimate the between group budget share equations under latent separability.

3. Application and results

3.1 The data

The data we use in this study are drawn from the 1990 Tunisian Household consumption Survey published by the National Statistics Institute INS. This survey reports the expenditures and quantities for food products and non food products for 7734 households. It provides information on many demographic household characteristics. We study the purchases of fifteen food products, the statistic characteristic of shares of all goods are presented in the first table B1 in Appendix B.

The expenditures for foods are grouped into five categories. The first category “Cereals” consists of the subcategories (Hard wheat, Tender wheat and Other wheat), the second category “Vegetables” contains expenditures for Vegetables and Fruits. The third category is called “Meats” and it contains expenditures for Meat, Poultry and eggs and Fish. The four category “Oils” consists of Mix Oils and Olive Oils. Finally, the last category “Other food products” contains Milk, Sugar, Other sugar products, canned foods and other food products.

4.2 Weak separability and the effect of SL-prices

The demand model we estimate is the quadratic almost ideal demand system (QAIDS) developed by (Banks and al., 1997). It is a generalization of the almost ideal demand system (AIDS) of Deaton (1980), it allows a good to be a luxury to some income levels and to be a necessity in others income levels.

For each individual household we define w_i to be the expenditure share on commodity i with total expenditure x and the log price vector $\ln p$. The QAIDS model expenditure shares have the form

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i (\ln x - \ln a(p)) + \lambda_i \frac{(\ln x - \ln a(p))^2}{b(p)}$$

Where

$$\ln a(p) = \alpha^T \ln p + \frac{1}{2} \ln p^T \ \Gamma \ln p$$

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i}$$

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i \ln(p_i) \quad \text{with} \quad \sum_{i=1}^{n} \lambda_i = 0$$

Such that $\alpha = (\alpha_1, \ldots, \alpha_N)^T$, $\beta = (\beta_1, \ldots, \beta_N)^T$, $\lambda = (\lambda_1, \ldots, \lambda_N)^T$ and $\Gamma = \begin{pmatrix} \gamma_1' \\ . \\ . \\ . \\ \gamma_N' \end{pmatrix}$

As in any demand system, this model embodies theoretical restrictions as adding up which is satisfied by deleted one equation of the system to avoid a singularity in the variance and covariance matrix of residuals. Homogeneity and symmetry can be imposed and tested as restrictions on the parameter vectors and negativity can not be imposed but can be tested looking at the sign of slutsky matrix.

To deal with the problem of endogeneity of total expenditure, a generalized method of moments (GMM) estimation procedure is used. The most invoked instrument for total expenditure is income. To test and correct the problem of endogeneity, the estimation follows two stages. In the first stage, we regress the total expenditure $\ln x$ on the instruments z such that age, age squared, educational dummies, educational$\times$age, relative prices, income and income squared, compute residuals $\hat{v}$. These instruments are strongly significant (the results are presented in table B2 of Appendix B. At the second stage, we regress w_i on both log total expenditure and residuals $\hat{v}$. Moreover, the test of the exogeneity of total expenditure $\ln x$ is equivalent to testing for the significance of the coefficient of the residual $\hat{v}$. We estimate the model without the homogeneity and slutsky symmetry restrictions $\Gamma 1_n = 0$ and $\Gamma = \Gamma^T$, so these restrictions can be tested.

Table1. Price and total expenditure effects under weak separability

Compensated effects of price indices						
Group of goods	P1	P2	P3	P4	lnx	(lnx)^2
Cereals	-0,002 (-7,75)	-0,001 (-4,07)	-0,003 (-6,88)	-0,001 (-3,61)	0,1027 (3,08)	-.0093 (-4,22)
Vegetables	0,0023 (0,89)	-0,00222 (-8,31)	0,0033 (0,69)	-0,00631 (-2,29)	-0,1124 **(-1,51)**	0,0113 (5,34)
Meats	0,00140 (7,9)	0,0024 (0,75)	0,0031 (0,55)	0,0011 (3,39)	-0,2656 (-1,96)	0,0128 (5,05)
Oils	-0,0019 (-11,96)	-0,0058 (-3,48)	0,0045 (1,51)	0,0044 (2,57)	0,00136 (0,07)	-0,00045 (-0,34)
Compensated effects of SL- prices						
Group of goods	SL1	SL2	SL3	SL4	lnx	(lnx)^2
Cereals	-0,0035 (-3,62)	0,0028 (1,82)	-0,00139 (-2,62)	-0,0140 (-15,46)	0,1718 (5,36)	-0,0091 (-4,17)
Vegetables	0,0055 (2,59)	-0,0021 (-2,31)	0,002156 (1,97)	-0,00098 (-2,10)	-0,1088 (-3,47)	0,0132 (6,17)
Meats	-0,0022 (-3,88)	0,00803 (1,82)	-0,0152 (-11,22)	0,00957 (17,61)	0,0257 (2,34)	0,00062 (2,05)
Oils	-0,00453 (-4,07)	-0,0068 (-3,56)	-0,0165 (-6,11)	-0,0025 (-2,37)	-0,303 (-8,14)	0,0123 (4,86)

Note: values in parentheses indicate the *t-ratio*

Table 1 presents the slutsky matrix using the classic price indices under weak separability, the compensated own price effects of goods Cereals and Vegetables are negative but the compensated own price effects of Meats and Oils are positive. Most of the compensated cross price effects are not statistically significant. Turning to the analysis of the table of Slutsky matrix in the case of SL- prices, we remark that all own price effects are negative.

Furthermore, they are stronger than the compensated own price effects in the case of price indices. For example Cereals and Vegetables have compensated own price effects of (-0,003) and (-0,002) respectively in the case of SL- prices but in the case of price indices have compensated own price effects of (-0,012) and (-0,041) respectively.
Furthermore, the analysis of slutsky matrix in the case of SL- prices show that the compensated own price effects of Meats and Oils that are positive in the case of price indices turn to negative (-0,0152) and (-0,025). We note that all compensated cross price effects are negative. Consequently, the composite commodity slutsky matrix in the case of SL prices is negative semi definite.

Table2. Estimated price and budget elasticities

Price and budget elasticities using price indices					
Group of goods	Elasticities Cereals price	Elasticities Vegetables price	Elasticities Meats price	Elasticities Oils price	Elasticities totexp
Cereals	-1, 187 (-1,6)	0, 405 (1,32)	-0,312 (-1, 89)	-0,098 (-2,56)	1,716 (1,98)
Vegetables	0,0105 (1 ,9)	-1,203 (-11)	0,265 (1,62)	-0, 027 (-1, 05)	0,856 (2,85)
Meats	0, 213 (1, 9)	0, 197 (2, 93)	0, 675 (1,71)	0, 215 (2,33)	1,007 (6,34)
Oils	0,254 (5,3)	-0,081 (-1, 45)	-0,084 (-1, 38)	- 0, 987 (-5,42)	0,9412 (3,01)
Price and budget elasticities using SL- prices					
Group of goods	Elasticities Cereals price	Elasticities Vegetables price	Elasticities Meats price	Elasticities Oils price	Elasticities totexp
Cereals	-0, 988 (-13,2)	-0, 203 (-2,13)	0,218 (3,18)	-0,136 (-1,93)	1,3867 (1,98)
Vegetables	0,066 (2,91)	-0, 954 (-7,14)	0,154 (3,64)	0,062 (2, 19)	0,9913 (2,85)
Meats	0, 124 (5,27)	-0, 168 (-3,04)	-0, 776 (-10,82)	0, 072 (1,89)	1,1342 (4,13)
Oils	0,165 (6,23)	0, 014 (4, 54)	0,159 (5, 62)	- 0, 833 (-3,11)	0,9096 (2,98)

Note: values in parentheses indicate the *t-ratio*

Table 2 reports the estimated price and budget elasticities using price indices. The results show that the own price elasticities are all negative and statistically significantexcept for Meats. Most of cross price elasticities are positive and are not statistically significant. The elasticity estimates of each budget share with respect to price indices are all positives and statistically significant. The elasticities of Cereals and Meats are larger than one and those of Vegetables and Oils are smaller than one. Hence, we can conclude that vegetables and Oils are both necessities and Meats and Cereals are luxuries goods. While in the case of SL-prices, the own price elasticities are all negative and statistically significant. Most of cross price elasticities that are positive or not stistically significant using price indices turn to negative or significant using SL- prices such that Cereals and Vegetables (change to 0,405 to -0,203). The use of SL- prices leads to precise estimation of the budget share elasticities .

Cereals and Meats are larger than one. So, they are luxuries goods but the budget share elasticities of vegetables and Oils are smaller than one, so they are both necessities.Using price indices, cereals a luxury good while in the case of SL- prices it appears to be a necessity.

4.3 Empirical results with latent separability

Using the rank test described in section 2, we find that the rank of the trimmed matrix $\overline{\Theta}|$ of estimates parameters is seven and thus M (the number of exclusive groups) is eight[6]. The value of the χ^2_{256} test statistic was (145, 57). There fore, we were able to aggregate these fifteen goods into eight latent separable groups. These results confirm our view that latent separability provides an interpretable and acceptable structure to place on consumer preferences.

To identify the composition of the latent groups we need a prior choice of exclusive goods. There are many row and column permutations that do not reject M=8. First, we drop those that correspond to a singular solution. Then, there remain a number of possible decompositions that give approximately the same value for the minimum chi-square criteria. In table2, we present the exclusive goods chosen: Hard Wheat, Vegetables, Meat, Poultry and Eggs, Olive Oils, Canned Foods and Milk. The results shows some interesting combination of goods, such that Mix Oils and Olive Oils, Hard wheat, Tender Wheat and Other Wheat. We note also that there are a number of goods that enter more than one group but there are some goods that are exclusive to their own groups.

The estimated results show a higher precision of the price elasticities, there are all negatives with a significant $|t|$ values. But there is not surprisingly on the precision of the expenditure elasticities estimates. So, we can conclude that latent separability improve the precision of price elasticities but does not place the restrictive structure on expenditure elasticities.

Table3.Price effects and estimates elasticities of exclusive goods

	Results using price indices		***Results using SL prices***	
Exclusive goods	***Price effects***	***Elasticity Price***	***SL- prices effects***	***Elasticity Price***
Hard Wheat	-0,0971 (-27, 58)	-0,841 (-34,37)	-0,084 (-4.12)	-1,214 (-12,42)
Vegetables	-0,0070 (-2,57)	-0,969 (-33,59)	0,0010 (3.48)	-0,904 (-4,37)
Meats	0,0299 (9,29)	-0,672 (-17,47)	-0,0044 (-3.93)	-1,104 (-21,83)
Poultry and eggs	0,0257 (12,27)	-0,547 (-14,24)	0,0171 (7.64)	-0,764 (-5,21)
Olive oils	-0,0361 (-23,06)	-0,894 (-15,35)	0,0055 (7.15)	-1,780 (-9,05)
Canned foods	-0,0079 (-6,60)	-0,668 (-17,24)	-0,0028 (-3.23)	-0,696 (-3,01)
Milk	0,0224 (16,88)	-1,231 (-7,91)	-0,0024 (-4.03)	-1,342 (-17,19)

Note: values in parentheses indicate the *t-ratio*

[6] See proposition 4 in Blundell and Robin (2000)

The analysis of this table shows that the results obtained with latent SL prices are more precise than those obtained in table6. The SL price effects of exclusive goods are all significant and show a high degree of precision compared to price effects obtained with simple price indices. Under latent separability, the estimates of price elasticities are statistically significant and theyimproves dramatically. Pice elasticities become very sensitive to the choice of exclusive goods with SL prices. We conclude that SL prices play an important role for the analysis of demand system and

L'analyse du tableau7 montre que les résultats obtenus avec les prix à la Stone-Lewbel sont plus précis que ceux obtenus dans le tableau6. Les effets prix estimés sous la base des biens exclusifs en utilisant les indices des prix à la Stone- Lewbel sont tous significatifs et montrent une grande précision par rapport aux résultats trouvés avec les indices des prix simples. Sous l'hypothèse de la séparabilité latente, les élasticités prix estimés sont statistiquement significatives et elles sont presque toutes conformes à l'intuition économique. Les élasticités prix propres deviennent très sensibles aux choix des biens exclusifs avec les indices des prix de Stone- Lewbel. La comparaison des tableaux 6 et 7 montre plus de précision aux niveaux des produits céréaliers à base de blé dur, viandes rouges, laits et dérivés et autres produis alimentaires dont leurs demandes deviennent élastiques. Par conséquent, les indices des prix à la Stone- Lewbel jouent un rôle important pour l'analyse de la demande.

5. Conclusion

This paper presents a new form of Stone-Lewbel cross section prices developed under latent separability. It provides two empirical applications: the first is to estimaite QAIDS model of five commodities under weak separability using classic price indices and SL prices. The second is to estimate QAIDS model of exclusive goods using latent price indices and latent SL prices. A grouping into height latent separable groups was found to be acceptable. The identification of these groups based on the choice of one exclusive good per group. There resulting estimates showed a considerable improvement in the precision of price elasticities. The empirical results using latent SL prices of exclusive goods seem to be reasonable. They are not just more plausible in terms of the sign of the coefficients. Also, they show a higher precision of the parameter estimates. When comparing the results, we would opt for the use of latent SL prices. They resolve the problem of insufficient and non stationary price variation in practise, and recommend their use.

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APPENDIX A

A1. Rank test (Kleibergan and Paap, [2006])

Let Θ be a $(k \times m)$ matrix of parameters estimates that have singular values decomposition:

$$\Theta = USV' \tag{2}$$

Where U is a ($k \times k$) orthonormal matrix ($U'U = I_k$), V is a ($m \times m$) orthonormal matrix ($V'V = I_m$) and S is a $(k \times m)$ matrix that contains the singular values of Θ on its main diagonal.

The rank of the matrix Θ under under the null hypothesis H_0 : rk (Θ) $= q$ with $q < \min(k, m)$ requires to construct a statistic based on a quadratic form of a (orthogonal) transformation of the smallest singular values of estimate of the matrix of parameters and on the inverse of the covariance matrix of parameters estimates. The limiting distribution of rank statistic is $\chi^2{}_{(k-q)(k-q)}$.

APPENDIX B

Table B1: Descriptive Statistics of Budget Shares

Variable	Obs	Mean	Std. Dev.	Min	Max
wbld	7734	.1035916	.097194	0	.7448443
wblt	7734	.0556208	.0454079	0	.4487244
wace	7734	.0265118	.0328461	0	.5943549
wleg	7734	.1521292	.0725402	0	.6103399
wfru	7734	.0554255	.0635184	0	.5959917
wvrg	7734	.1729718	.0945922	0	.5699675
wvol	7734	.0589877	.0484576	0	.4357985
wlai	7734	.0770223	.0685394	0	.6237678
wsuc	7734	.0290388	.0187129	0	.2180766
wpsu	7734	.0055155	.0167031	0	.3768967
whui	7734	.030308	.0261461	0	.3327674
woli	7734	.0396134	.059134	0	.6833566
wpoi	7734	.0212881	.0333189	0	.3382829
wcns	7734	.0663245	.0342877	0	.264811
wali	7734	.1056509	.0864386	0	.8007142

Table B2: Results of instrumental regression

lntotexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
zone	.176621	.0132138	13.37	0.000	.1507184	.2025236
tai	.0912048	.0024231	37.64	0.000	.0864549	.0959548
scp	.1892552	.0117147	16.16	0.000	.1662912	.2122192
age	.0143376	.0037034	3.87	0.000	.0070779	.0215972
age2	-.0001395	.0000273	-5.11	0.000	-.000193	-.0000859
educ1	-.5213965	.1197231	-4.36	0.000	-.7560863	-.2867067
educ2	-.3903199	.1196684	-3.26	0.001	-.6249025	-.1557373
educ3	-.2511987	.1276333	-1.97	0.049	-.5013947	-.0010026
H1	.0054148	.0025759	2.10	0.036	.0003653	.0104644
H2	.0061013	.0026269	2.32	0.020	.0009518	.0112508
H3	.0072829	.0028714	2.54	0.011	.0016541	.0129117
luvbld	.1361253	.0234422	5.81	0.000	.0901722	.1820785
luvblt	.0687102	.0370867	1.85	0.064	-.0039899	.1414102
luvace	-.0096595	.0063666	-1.52	0.129	-.0221397	.0028208
luvleg	.1881596	.0182831	10.29	0.000	.1523197	.2239994
luvfru	-.0381838	.0063928	-5.97	0.000	-.0507155	-.0256521
luvvrg	.1523978	.0209967	7.26	0.000	.1112386	.193557
luvvol	-.010386	.0233792	-0.44	0.657	-.0562157	.0354436
luvlai	-.0697887	.0109937	-6.35	0.000	-.0913393	-.0482381
luvsuc	.1887929	.0608775	3.10	0.002	.0694565	.3081293
luvpsu	-.0242898	.0048243	-5.03	0.000	-.0337468	-.0148328
luvhui	.0740426	.0353881	2.09	0.036	.0046722	.143413
luvoli	-.0035011	.0107877	-0.32	0.746	-.024648	.0176457
luvpoi	.1464528	.0095931	15.27	0.000	.1276477	.165258
luvcns	.0762089	.0200535	3.80	0.000	.0368985	.1155193
luvali	.0406443	.0078707	5.16	0.000	.0252156	.056073
_cons	6.687551	.1585918	42.17	0.000	6.376668	6.998434